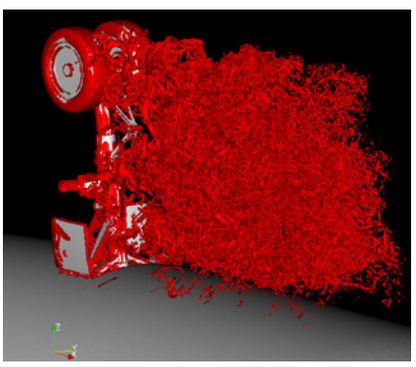
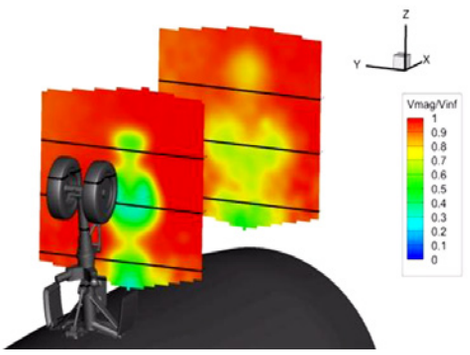
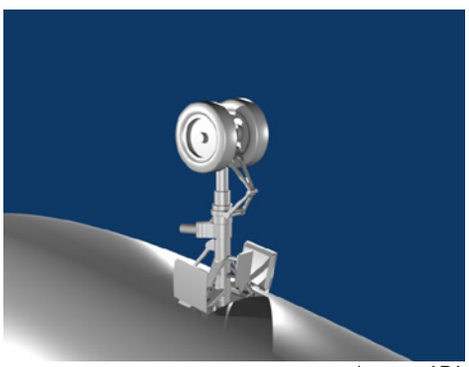
Advanced CFD reduces aircraft noise and emissions







Images: ARA

The Aircraft Research Association (ARA) is an independent research and development organisation providing a range of specialist services to the aerospace industry; including high speed wind tunnel testing, Computational Fluid Dynamics, and high precision wind tunnel model design and manufacture.

The challenge

There is a strong drive within the aircraft industry for vehicles that have less environmental impact in terms of both noise and gaseous emissions. Reducing noise requires an understanding of the sources of aerodynamic noise, and reducing gaseous emissions presents challenges in terms of designing both leaner engines and airframes with reduced drag.

As part of a project to analyse commercial aircraft landing gear/cavity aerodynamics and acoustics, ARA wanted to carry out a complex, holistic simulation of the landing gear using Computational Fluid Dynamics (CFD). However ARA's internal computing resource is of the order of a few hundred cores, and it was clear from the outset that this would not be adequate for performing the landing gear simulation. It was estimated that at least 2000 cores would be needed to obtain the precision required.

After discussion with several potential resource providers, it became clear to ARA that ARCHER, a Cray XC 30 hosted by EPCC, was the best option to meet the HPC requirements at a cost consistent with the available project budget.

How we helped

EPCC worked with ARA in porting its modelling and simulation workflows to the ARCHER platform. It was decided to perform the mesh generation phase of the CFD process at ARA and then export the TAU flow simulation phase to ARCHER. The landing gear simulation used 88 nodes of the Cray XC 30, providing access to a total of 2112 cores. This significant increase in capability was instrumental in accelerating time to results and ultimately leading to a successful project outcome.

The benefits

ARCHER enabled ARA to perform its largest CFD simulation ever: this simulation would never have taken place if ARA had relied solely on its own in-house computing resource. The simulation results for the civil aircraft landing gear geometry, alongside the wind tunnel data taken in a companion experimental test, allowed the numerical approach to be validated, and additionally for insight into the complex flow physics to be obtained.

Computations such as this will pave the way for increased use of CFD in landing gear assembly design, leading to improved designs which are more environmentally friendly.

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